

selenium; and a remaining percentage, by weight, of zinc, wherein the percent by weight of copper, silicon, aluminum, and phosphorous in the copper alloy satisfy the relationship

$$60 \leq X - 3Y + aZ + bW \leq 70,$$

wherein

X is the percent, by weight, of copper,

Y is the percent, by weight, of silicon,

Z is the percent, by weight, of aluminum,

W is the percent, by weight, of phosphorous,

a is -2, and

b is -3; and

the copper alloy has a metal construction comprising multiple phases integrated to form a composite phase, wherein the composite phase is an α phase matrix having a total phase area comprising not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase.

10. A free-cutting copper alloy, consisting essentially of 69 to 79 percent, by weight, of copper; 2.0 to 4.0 percent, by weight, of silicon; 0.02 to 0.4 percent, by weight, of lead; 0.1 to 1.5 percent, by weight, of aluminum; 0.02 to 0.25 percent, by weight, of phosphorus; at least one element selected from among 0.02 to 0.4 percent, by weight, of chromium and 0.02 to 0.4 percent, by weight, of titanium; and a remaining percentage, by weight, of zinc, wherein the percent by weight of copper, silicon, aluminum, phosphorous and chromium in the copper alloy satisfy the relationship

$$60 \leq X - 3Y + aZ + bW + cV \leq 70,$$

wherein

X is the percent, by weight, of copper,

Y is the percent, by weight, of silicon,

Z is the percent, by weight, of aluminum,
W is the percent, by weight, of phosphorous,
V is the percent, by weight, of chromium,
a is -2,
b is -3, and
c is 2; and

the copper alloy has a metal construction comprising multiple phases integrated to form a composite phase, wherein the composite phase is an α phase matrix having a total phase area comprising not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase.

11. A free-cutting copper alloy, consisting essentially of 69 to 79 percent, by weight, of copper; 2.0 to 4.0 percent, by weight, of silicon; 0.02 to 0.4 percent, by weight, of lead; 0.1 to 1.5 percent, by weight, of aluminum; 0.02 to 0.25 percent, by weight, of phosphorus; at least one element selected from among 0.02 to 0.4 percent, by weight, of chromium and 0.02 to 0.4 percent by weight of titanium; one element selected from among 0.02 to 0.4 percent, by weight, of bismuth, 0.02 to 0.4 percent, by weight, of tellurium and 0.02 to 0.4 percent, by weight, of selenium; and a remaining percentage, by weight, of zinc, wherein the percent by weight of copper, silicon, aluminum, phosphorous and chromium in the copper alloy satisfy the relationship

$$60 \leq X - 3Y + aZ + bW + cV \leq 70,$$

wherein

X is the percent, by weight, of copper,
Y is the percent, by weight, of silicon,
Z is the percent, by weight, of aluminum,
W is the percent, by weight, of phosphorous,
V is the percent, by weight, of chromium,

